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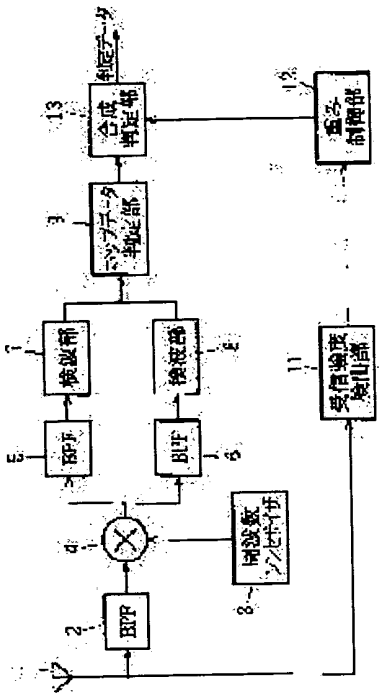
(54) RECEPTION DEVICE FOR SPREAD SPECTRUM COMMUNICATION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a reception device for spread spectrum communication which can maintain excellent characteristics in interference environment and also secure noise-resistance characteristics equivalent to those of a linear composition system.
SOLUTION: The reception device for spread spectrum communication which uses a high-speed frequency hopping system making multiple hops for every data bit has a hop data decision part 9 which decides data for each hop, a reception intensity detection part 11 which detects the reception intensity of each hop, a weight control part 12 which performs a weight operation with the reception intensity of each hop detected by the detection part 11, and a composition decision part 13 which decides data by synthesizing individual pieces of hop data decided by the hop data decision part 9 according to the weight found by the weight control pat 12.



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CLAIMS

[Claim(s)]
[Claim 1] The receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which is characterized by providing the following and which carries out multiple-times hop per 1 bit of data. The hop data judging section which carries out a data judging about each hop. The receiving on-the-strength detecting element which detects the receiving intensity of each hop. The weight control section which performs a weight operation with the receiving intensity of each hop detected by the aforementioned receiving on-the-strength detecting element. The synthetic judgment section which compounds each hop data judged in the aforementioned hop data judging section with the weight called for in the aforementioned weight control section, and performs a data judging.
[Claim 2] The receiving set for spectrum diffusion communication according to claim 1 characterized by providing the following. The aforementioned weight control section is the maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop. The average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity. A comparator [search for the level difference of the aforementioned maximum receiving intensity and the aforementioned average receiving intensity, and / difference / level / aforementioned / threshold]. Weight operation part which determines weight based on the comparison result of the aforementioned comparator.
[Claim 3] The receiving set for spectrum diffusion communication according to claim 1 characterized by providing the following. The aforementioned weight control section is the maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop. The minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop. A comparator [search for the level difference of the aforementioned maximum receiving intensity and the aforementioned minimum receiving intensity, and / difference / level / aforementioned / threshold]. Weight operation part which determines weight based on the comparison result of the aforementioned comparator.
[Claim 4] The receiving set for spectrum diffusion communication according to claim 1 characterized by providing the following. The aforementioned weight control section is the maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop. The average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity. The 1st comparator [search for the level difference of the aforementioned maximum receiving intensity and the aforementioned average receiving intensity, and / difference / level / aforementioned / the 1st threshold]. the weight operation part which searches for each level difference of the aforementioned maximum receiving intensity and the receiving intensity of each hop, and determines weight as the 2nd comparator [difference / level / of each above / the 2nd threshold] based on the above 1st and the comparison result of the 2nd comparator
[Claim 5] The receiving set for spectrum diffusion communication according to claim 1 characterized by providing the following. The aforementioned weight control section is the maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop. The minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop. The 1st comparator [search for the level difference of the aforementioned maximum receiving intensity and the aforementioned minimum receiving intensity, and / difference / level / aforementioned / the 1st threshold]. Weight operation part which searches for each level difference of the aforementioned maximum receiving intensity and the receiving intensity of each hop, and determines weight based on the comparison result of the 2nd comparator [difference / level / aforementioned / the 2nd threshold], and the above 1st and the 2nd comparator.
[Claim 6] It is the receiving set for spectrum diffusion communication which is equipped with the following and characterized by the aforementioned synthetic judgment section compounding each hop judging data based on the

weight from the aforementioned weight control section. The hop data judging section which carries out a data judging about each hop and which is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data, and is outputted as hop judging data. The synthetic judgment section which compounds each hop judging data from the aforementioned hop data judging section, and performs a data judging. The hop data error judging section which performs comparison with the judgment data outputted from the aforementioned synthetic judgment section, and each hop judging data outputted from the aforementioned hop data judging section, and judges whether it is an error. The weight control section which determines weight based on the error judging result stored in the error memory which memorizes the error judging result outputted from the aforementioned hop data error judging section, and the aforementioned error memory.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the receiving set for spectrum diffusion communication which uses a high-speed frequency-hopping method with a hopping speed quicker than information symbol speed.
[0002]
[Description of the Prior Art] Conventionally, since spread spectrum communication is excellent in coherence-proof, secrecy nature, etc., it is used in the field of satellite communication and land communication. A frequency-hopping method is in one of the spread spectrum communication of this. By changing dispersedly at random in the band which gave the carrier frequency modulated using information, a frequency-hopping method is a method diffused in a wide band. A frequency-hopping method is further divided into two, high-speed frequency hopping and low-speed frequency hopping, by hopping speed.
[0003] Two or more data are transmitted on one frequency, a frequency-hopping rate calls frequency hopping of a low case low-speed frequency hopping rather than a data rate, and frequency hopping when a frequency-hopping rate is higher than a data rate is called high-speed frequency hopping (it is hereafter indicated as "high speed FH"). By the high-speed FH method, since one symbol is transmitted on two or more frequency, a good property can be acquired to frequency-selective phasing, such as multi-pass phasing.
[0004] There are an alignment composite system which is a method which judges data as a composite system in this high-speed FH method after compounding a detection output in analog, and a hard limiter composite system which is the method of carrying out data processing after making each hop data binary previously. An alignment composite system has few losses generated at the time of composition since the detection output is compounded in analog, it ends, and it is the feature to excel in the opposite noise figure which is a basic property. However, when realizing an alignment composite system by hardware, a big dynamic range is needed, and it may be saturated if a signal is large. Therefore, since a compensating circuit is needed and a circuit scale increases, the case which uses a hard limiter composite system with the cost merit by simplification of circuitry is common. This hard limiter composite system has a good property under strong interference environment, and has the interference exclusion force also to radiation of strong level, such as a microwave oven.
[0005] Drawing 7 is the block diagram showing the receiving set for spectrum diffusion communication of the conventional high-speed FH method which uses a hard limiter composite system. If it is a mark (data "1") as an information modulation technique and is a space (data "0") about the sine wave of the frequency of fc+delta f here, BFSK (Binary Fre-quency Shift Keying) which outputs the sine wave of the frequency of fc-delta f is assumed. fc is the carrier frequency by which hopping patternizing was carried out.
[0006] The antenna which 1 receives the radio information from a transmitter and outputs an input signal in drawing 7 , The band pass filter to which 2 reduces spectrum other than a diffusion band The frequency synthesizer which outputs the signal of frequency with which only the intermediate frequency fIF shifted from fc which is the hopping pattern as a transmitter with 3 [same] (hereafter indicated to be "BPF") one after another, The frequency converter which 4 performs frequency mixing with the input signal from an antenna 1 and the output signal from a frequency synthesizer 3 through BPF2, and outputs an intermediate frequency fIF, The bandwidth BPF which 5 makes pass the spectrum of frequency fIF+delta f corresponding to the mark, BPF which 6 makes pass the spectrum of fIF-delta f corresponding to the space, The detection section which detects the level of each hop to which 7 was outputted by ********** etc. from BPF5, The detection section which detects the level of each hop to which 8 was outputted from BPF6, and 9 are marked for every hop data. The hop data judging section which judges hop data, and 10 are the majority judging sections which perform the mark outputted from the hop data judging section 9, and the majority judging of a space,

and perform a data judging by comparing level about a space and making it binary.
[0007] Thus, the operation is explained about the constituted receiving set for spectrum diffusion communication.
[0008] The signal (input signal) received by the antenna 1 passes only a diffusion frequency band signal by BPF2. If it is a mark and is fIF+deltaf and a space when the hopping synchronization can be taken and the sine wave which is the frequency of fc+fIF is multiplied by this band-limited signal by the frequency converter 4 by the frequency synthesizer 3, the frequency component of fIF-delta f is outputted. BPF6 cannot be passed although the output from a frequency converter 4 can pass BPF5 in a mark. BPF5 cannot be passed although BPF6 can pass by the reverse in the case of a space. The detection sections 7, such as an envelope detection, and the detection section 8 perform level detection to the output of BPF5 and BPF6, respectively. The hop data judging section 9 judges hop data by comparing the output level of the detection section 7 and the detection section 8 for every hop. It is the structure which judges the data received by the majority judging section 10 as counted the mark and the number of hop of a space which were judged in the hop data judging section 9 and made the more numerous one the data value.
[0009]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional receiving set for spectrum diffusion communication, in order to use a majority judging as the judgment method in a hard limiter composite system, the static characteristic (for example, opposite noise figure) which is a basic property had the trouble of becoming bad theoretically rather than an alignment composite system. Moreover, it had the trouble that the aperture of the performance difference of both methods became large further under phasing environment. Furthermore, as mentioned above, in the conventional alignment composite system, the circuit scale became large and it had the trouble of carrying out performance degradation to the bottom of still stronger interference environment as compared with a hard limiter composite system.
[0010] In this receiving set for spectrum diffusion communication, it is required that about the same opposite noise figure as an alignment composite system should be securable, maintaining the good property under the interference environment which is the strong point of a hard limiter composite system by performing middle-processing with the alignment composition and hard limiter composition composition in high speed FH.
[0011] It aims at offering the receiving set for spectrum diffusion communication which can secure about the same opposite noise figure as an alignment composite system while it can maintain the good property under interference environment, since this invention fills this demand.
[0012]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem the receiving set for spectrum diffusion communication of this invention The hop data judging section which is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data, and carries out a data judging about each hop, The receiving on-the-strength detecting element which detects the receiving intensity of each hop, and the weight control section which performs a weight operation with the receiving intensity of each hop detected by the receiving on-the-strength detecting element, It has the composition which has the synthetic judgment section which compounds each hop data judged in the hop data judging section with the weight called for in the weight control section, and performs a data judging.
[0013] Thereby, while the good property under interference environment is maintainable, the receiving set for spectrum diffusion communication which can secure about the same opposite noise figure as an alignment composite system is obtained.
[0014]
[Embodiments of the Invention] The receiving set for spectrum diffusion communication of this invention according to claim 1 The hop data judging section which is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data, and carries out a data judging about each hop, The receiving on-the-strength detecting element which detects the receiving intensity of each hop, and the weight control section which performs a weight operation with the receiving intensity of each hop detected by the receiving on-the-strength detecting element, Suppose that it has the synthetic judgment section which compounds each hop data judged in the hop data judging section with the weight called for in the weight control section, and performs a data judging.
[0015] Since the hard limiter composite system of using the hop judging data made binary at the synthetic judgment section is using while being able to earn synthetic gain as compared with the majority judging which is an exclusive operation and being able to secure good opposite noise figure by this composition, since weighting to the judgment result of each hop with the value by which the weight operation was carried out according to receiving intensity is performed, it has operation that it is maintainable in the good property under interference environment.
[0016] The receiving set for spectrum diffusion communication according to claim 2 In the receiving set for spectrum

diffusion communication according to claim 1 a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, Suppose that it has a comparator [difference / level / threshold] and the weight operation part which determines weight based on the comparison result of a comparator by searching for the level difference of the average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, and the maximum receiving intensity and average receiving intensity.

[0017] Since it can be made zero or it lessens weight of the maximum on-the-strength reception hop, when a level difference with average receiving intensity becomes large, and the level difference considers that the receiving intensity of the hop which has received interference exceeds a threshold and it exceeds a threshold by this composition, it has operation that influence of interference can be lessened further.

[0018] The receiving set for spectrum diffusion communication according to claim 3 In the receiving set for spectrum diffusion communication according to claim 1 a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, Suppose that it has a comparator [difference / level / threshold] and the weight operation part which determines weight based on the comparison result of a comparator by searching for the level difference of the minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop, and the maximum receiving intensity and the minimum receiving intensity.

[0019] Since it can be made zero or it lessens weight of the maximum on-the-strength reception hop, when a level difference with the minimum receiving intensity becomes large, and the level difference considers that the receiving intensity of the hop which has received interference exceeds a threshold and it exceeds a threshold by this composition, it has operation that influence of interference can be lessened further.

[0020] The receiving set for spectrum diffusion communication according to claim 4 In the receiving set for spectrum diffusion communication according to claim 1 a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, The 1st comparator [search for the level difference of the maximum receiving intensity and average receiving intensity, and / difference / level / the 1st threshold], Each level difference of the maximum receiving intensity and the receiving intensity of each hop is searched for, and suppose that it has the 2nd comparator [difference / level / each / the 2nd threshold] and the weight operation part which determines weight based on the 1st and the comparison result of the 2nd comparator.

[0021] Since it can be made zero by this composition or it considers that the hop has also received interference and lessens weight with the maximum receiving on-the-strength reception hop when there is hop with few the maximum receiving intensity and level differences, it has operation that influence of interference can be lessened further.

[0022] The receiving set for spectrum diffusion communication according to claim 5 In the receiving set for spectrum diffusion communication according to claim 1 a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop, The 1st comparator [search for the level difference of the maximum receiving intensity and the minimum receiving intensity, and / difference / level / the 1st threshold], Each level difference of the maximum receiving intensity and the receiving intensity of each hop is searched for, and suppose that it has the 2nd comparator [difference / level / the 2nd threshold] and the weight operation part which determines weight based on the 1st and the comparison result of the 2nd comparator.

[0023] Since it can be made zero by this composition or it considers that the hop has also received interference and lessens weight with the maximum receiving on-the-strength reception hop when there is hop with few the maximum receiving intensity and level differences, it has operation that influence of interference can be lessened further.

[0024] The receiving set for spectrum diffusion communication according to claim 6 The hop data judging section which carries out a data judging about each hop and which is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data, and is outputted as hop judging data, The synthetic judgment section which compounds each hop judging data from the hop data judging section, and performs a data judging, The hop data error judging section which performs comparison with the judgment data outputted from the synthetic judgment section, and each hop judging data outputted from the hop data judging section, and judges whether it is an error, The error memory which memorizes the error judging result outputted from the hop data error judging section, Having the weight control section which determines weight based on the error judging result stored in error memory, the synthetic judgment section decides to compound each hop judging data based on the weight from a weight control section.

[0025] Since it can carry out to zero or it memorizes the error generating situation for every hop by comparing each hop judging data with the judgment data after composition, it considers that interference has occurred in the frequency corresponding to the hop which the error generated by this composition and it lessens the weight to the hop corresponding to the frequency, it has operation that the influence of interference can be lessened further.
[0026] Hereafter, the form of operation of this invention is explained using drawing 1 - drawing 6 .
[0027] (Form 1 of operation) Drawing 1 is the block diagram showing the receiving set for spectrum diffusion communication of the high-speed FH method by the form 1 of operation of this invention. If it is a mark (data "1") as an information modulation technique and is a space (data "0") here about the sine wave of the frequency of fc+delta f as well as the conventional example, BFSK which outputs the sine wave of the frequency of fc-delta f is assumed. fc is the carrier frequency by which hopping patternizing was carried out.
[0028] In drawing 1 , since an antenna 1, BPF2, a frequency synthesizer 3, a frequency converter 4, BPF 5 and 6, the detection sections 7 and 8, and the hop data judging section 9 are the same as that of drawing 7 , the same sign is attached and explanation is omitted. The receiving on-the-strength detecting element to which 11 detects the receiving intensity of each hop, the weight control section which compute the weighting factor to each hop judging data based on the receiving intensity of each hop by which 12 was detected by the receiving on-the-strength detecting element 11, and 13 are the synthetic judgment section which performs in a weighting operation to each hop judging data from the hop data judging section 9 according to the weighting factor computed by the weight control section 12, and performs in a synthetic judgment.
[0029] The operation is explained about the receiving set for spectrum diffusion communication constituted as mentioned above.
[0030] The signal received by the antenna 1 passes only a diffusion frequency band signal by BPF2. If it is a mark and is fIF+deltaf and a space when the hopping synchronization can be taken and this band-limited signal and the sinusoidal signal which is the frequency of fc+fIF of frequency synthesizer 3 output are multiplied by the frequency converter 4, the frequency component of fIF-delta f is outputted. BPF6 cannot be passed although the output from a frequency converter 4 can pass BPF5 in a mark. BPF5 cannot be passed, although it is the reverse in the case of a space and the output from a frequency converter 4 can pass BPF6. The detection sections 7, such as an envelope detection, and the detection section 8 perform level detection to the output of BPF5 and BPF6, respectively. The hop data judging section 9 judges hop data by comparing the output level of the detection section 7 and the detection section 8 for every hop. Moreover, the receiving on-the-strength detecting element 11 detects the receiving intensity in each hop, and a weighting factor is computed according to the level of the receiving intensity of each hop by the weight control section 12. For example, a weighting factor is calculated with relative level so that receiving intensity may enlarge a weighting factor to strong hop as compared with other reception hop and receiving intensity may lessen a weighting factor to low hop. The synthetic judgment section 13 performs weighting composition of the maximum ratio composition etc. using the weighting factor computed by the weight control section 12 to the hop judging data from the hop data judging section 9, and a 1-bit data judging is performed.
[0031] Below, the example of the judgment method of 1-bit data is described. For example, 4 hop **** high speed FH is assumed per one symbol. Since a hop number is given to each hop in 1 bit, it considers as hop 1, hop 2, hop 3, and hop 4 here, respectively. The hop data judging section 9 presupposes that it judged with "1" (hop 1), "0" (hop 2), "1" (hop 3), and "0" (hop 4) as hop data. The result which calculated the weighting factor in each hop by the weight control section 12 based on the receiving intensity at this time is set to 4 (hop 1), 1 (hop 2), 2 (hop 3), and 3 (hop 4), and it transposes to -1, if it is +1 and "0", if each hop judging data is "1", and the synthetic judgment section 13 performs a weight operation. The operation value X in this case is set to X=+1x4-1x1+1x2-1x3=+2>0. That is, since the positive value X is drawn from this weight operation, the synthetic judgment section 13 judges that this data is "1." Judgment data are set to "0" when a negative value is drawn by the weight operation.
[0032] The hop data judging section 9 which carries out a data judging about each hop as mentioned above according to the form of this operation, The receiving on-the-strength detecting element 11 which detects the receiving intensity of each hop, and the weight control section 12 which performs a weight operation with the receiving intensity of each hop detected by the receiving on-the-strength detecting element 11, By having formed the synthetic judgment section 13 which compounds each hop data judged in the hop data judging section 9 with the weight called for by the weight control section 12, and performs a data judging Since weighting to the judgment result of each hop with the value by which the weight operation was carried out according to receiving intensity is performed While being able to earn synthetic gain as compared with the majority judging which is an exclusive operation and being able to secure good opposite noise figure Since the hard limiter composite system of using the hop judging data made binary in the synthetic judgment section is used, the good property under interference environment is maintainable.
[0033] (Form 2 of operation) Drawing 2 is the block diagram showing the weight control section of the receiving set

for spectrum diffusion communication of the high-speed FH method by the form 2 of operation of this invention. The composition of the receiving set for spectrum diffusion communication is the composition of drawing 1 like the form 1 of operation, and the weight control section of drawing 2 corresponds to the weight control section 12 of drawing 1 , and is constituted by receiving on-the-strength memory, a hop control section, the maximum receiving on-the-strength detecting element, an average receiving on-the-strength detecting element, a comparator, the threshold setting section, and weight operation part.

[0034] In drawing 2 , 21 consists of easy circuits, such as a flip-flop. The receiving on-the-strength memory which memorizes the receiving intensity in each hop, the hop timing-control section which writes in 22 to the receiving on-the-strength memory 21 corresponding to each hop, and outputs timing, The maximum receiving on-the-strength detecting element to which 23 detects the greatest level and a hop number out of the receiving intensity of all hop, The average receiving on-the-strength detecting element which takes the average of receiving intensity other than the hop by which 24 was detected by the maximum receiving on-the-strength detecting element 23, The comparator to which 25 outputs the threshold setting section and 26 outputs the comparison result of the level difference of the output of the maximum receiving on-the-strength detecting element 23 and the output of the average receiving on-the-strength detecting element 24 and the threshold of the threshold setting section 25, and 27 are weight operation part which determines a weighting factor by the output of a comparator 26.

[0035] The operation is explained about the weight control section constituted as mentioned above.

[0036] The receiving intensity in each hop is written in the receiving on-the-strength memory 21 by the timing according to the hopping timing which the hop timing-control section 22 outputs. By the output from the receiving on-the-strength memory 21, the maximum receiving on-the-strength detecting element 23 detects the level of a hop number with the strongest receiving intensity, and receiving intensity in all hop per bit. The average receiving on-the-strength detecting element 24 detects the average of receiving intensity other than the hop with the maximum receiving intensity, and the level difference of the maximum receiving intensity from the maximum receiving on-the-strength detecting element 23 and the average receiving intensity from the average receiving on-the-strength detecting element 24 is calculated by the comparator 26. Furthermore, when the value (that is, comparison result) calculated by the comparator 26 is over the threshold of the threshold setting section 25, it considers that the hop with the maximum receiving intensity has received interference, and or it lessens the weighting factor to the hop with the maximum receiving intensity to the weight operation part 27, it orders to make it zero. In this case, about hop other than the hop with the maximum receiving intensity, the weight operation part 27 computes a weighting factor like the form 1 of operation according to the level of the receiving intensity of hop. In addition, you may make it change dynamically the set point of the threshold to the threshold setting section 25 so that it can respond to change of the receiving environment by the external factor.

[0037] According to the form of this operation, as mentioned above the weight control section 12 The maximum receiving on-the-strength detecting element 23 which detects the maximum receiving intensity out of the receiving intensity of each hop, The average receiving on-the-strength detecting element 24 which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, By having searched for the level difference of the maximum receiving intensity and average receiving intensity, and having formed the comparator [difference / level / threshold] 26 and the weight operation part 27 which determines weight based on the comparison result of a comparator 26 As for the receiving intensity of the hop which has received interference, a level difference with average receiving intensity becomes large. Since it can be made zero or it lessens weight of the maximum on-the-strength reception hop, when it considers that the level difference exceeds a threshold and a threshold is exceeded, influence of interference can be lessened further.

[0038] (Gestalt 3 of operation) Drawing 3 is the block diagram showing the weight control section of the receiving set for spectrum diffusion communication of the high-speed FH method by the gestalt 3 of operation of this invention. The composition of the receiving set for spectrum diffusion communication is the composition of drawing 1 like the gestalt 1 of operation, and the weight control section of drawing 3 corresponds to the weight control section 12 of drawing 1 , and is constituted by receiving on-the-strength memory, a hop control section, the maximum receiving on-the-strength detecting element, the minimum receiving on-the-strength detecting element, a comparator, the threshold setting section, and weight operation part.

[0039] In drawing 3 , since the receiving on-the-strength memory 21, the hop timing-control section 22, the maximum receiving on-the-strength detecting element 23, the threshold setting section 25, a comparator 26, and the weight operation part 27 are the same as that of drawing 2 , the same sign is attached and explanation is omitted. 31 is the minimum receiving on-the-strength detecting element which detects the minimum level and a hop number out of the receiving intensity of all hop. With the gestalt of this operation, a comparator 26 outputs the comparison result of the level difference of the maximum receiving intensity from the maximum receiving on-the-strength detecting element

23, and the minimum receiving intensity from the minimum receiving on-the-strength detecting element 31, and the threshold of the threshold setting section 25. This point is just going to differ from the gestalt 2 of operation.
[0040] The operation is explained about the weight control section constituted as mentioned above.
[0041] The receiving intensity in each hop is written in the receiving on-the-strength memory 21 by the timing according to the hopping timing which the hop timing-control section 22 outputs. In all hop per bit, the maximum receiving on-the-strength detecting element 23 detects the level of a hop number with the largest receiving intensity, and receiving intensity by the output from the receiving on-the-strength memory 21. Moreover, the minimum receiving on-the-strength detecting element 31 detects the level of a hop number with the smallest receiving intensity, and receiving intensity, and the level difference of the maximum receiving intensity from the maximum receiving on-the-strength detecting element 23 and the minimum receiving intensity from the minimum receiving on-the-strength detecting element 31 is calculated by the comparator 26. Furthermore, when the value calculated by the comparator 26 is over the threshold of the threshold setting section 25, it considers that the hop with the maximum receiving intensity has received interference, and or it lessens the weighting factor to the hop with the maximum receiving intensity to the weight operation part 32, it orders to make it zero. In this case, to hop other than the hop with the maximum receiving intensity, the weight operation part 32 computes a weighting factor like the gestalt 1 of operation according to the level of the receiving intensity of hop. In addition, you may make it change dynamically the set point of the threshold of the threshold setting section 25 so that it can respond to change of the receiving environment by the external factor.
[0042] According to the form of this operation, as mentioned above the weight control section 12 The maximum receiving on-the-strength detecting element 23 which detects the maximum receiving intensity out of the receiving intensity of each hop, The minimum receiving on-the-strength detecting element 31 which detects the minimum receiving intensity out of the receiving intensity of each hop, By having searched for the level difference of the maximum receiving intensity and the minimum receiving intensity, and having formed the comparator [difference / level / threshold] 26 and the weight operation part 27 which determines weight based on the comparison result of a comparator 26 As for the receiving intensity of the hop which has received interference, a level difference with the minimum receiving intensity becomes large. Since it can be made zero or it lessens weight of the maximum on-the-strength reception hop, when it considers that the level difference exceeds a threshold and a threshold is exceeded, influence of interference can be lessened further.
[0043] (Gestalt 4 of operation) Drawing 4 is the block diagram showing the weight control section of the receiving set for spectrum diffusion communication of the high-speed FH method by the gestalt 4 of operation of this invention. The composition of the receiving set for spectrum diffusion communication is the composition of drawing 1 like the gestalt 1 of operation, and the weight control section of drawing 4 corresponds to the weight control section 12 of drawing 1 , and newly adds a comparator and the threshold setting section in the gestalt 2 of operation.
[0044] In drawing 4 , since the receiving on-the-strength memory 21, the hop timing-control section 22, the maximum receiving on-the-strength detecting element 23, and the average receiving on-the-strength detecting element 24 are the same as that of drawing 2 , the same sign is attached and explanation is omitted. It is the 1st comparator to which 41 outputs the 1st threshold setting section, and 42 outputs the comparison result of the level difference of the output of the maximum receiving on-the-strength detecting element 23, and the output of the average receiving on-the-strength detecting element 24, and the threshold of the 1st threshold setting section 41. The 1st threshold setting section 41 and 1st comparator 42 are the same as the threshold setting section 25 and the comparator 26 in the gestalt 2 of operation respectively. It is the 2nd comparator to which 43 outputs the 2nd threshold setting section, and 44 outputs the comparison result of the level difference of each hop receiving on-the-strength output of the receiving on-the-strength memory 21, and the output of the maximum receiving on-the-strength detecting element 23, and the threshold of the 2nd threshold setting section 43.
[0045] The operation is explained about the weight control section constituted as mentioned above.
[0046] The receiving intensity in each hop is written in the receiving on-the-strength memory 21 by the timing according to the hopping timing which the hop timing-control section 22 outputs. In all hop per bit, the maximum receiving on-the-strength detecting element 23 detects the level of a hop number with the strongest receiving intensity, and receiving intensity by the output from the receiving on-the-strength memory 21. The average receiving on-the-strength detecting element 24 detects the average of receiving intensity other than the hop with the maximum receiving intensity, and the level difference of the maximum receiving intensity from the maximum receiving on-the-strength detecting element 23 and the minimum receiving intensity from the average receiving on-the-strength detecting element 24 is calculated by the 1st comparator 42. Furthermore, when the value calculated by the 1st comparator 42 is over the value of the 1st threshold setting section 41, it considers that the hop with the maximum receiving intensity has received interference, and or it lessens the weighting factor to the hop with the maximum receiving intensity to the weight operation part 45, it orders to make it zero. In this case, to hop other than the hop with the maximum reception,

the weight operation part 45 computes a weighting factor like the gestalt 1 of operation according to the level of the receiving intensity of hop. In addition, you may make it change dynamically the set point of the threshold of the 1st threshold setting section 41 so that it can respond to change of the receiving environment by the external factor. It is the operation same so far as the gestalt 2 of operation.

[0047] With the form of this operation, the level difference of the value of the receiving on-the-strength memory 21 and the output of the maximum receiving on-the-strength detecting element 23 which store the receiving intensity of each hop is further calculated by the 2nd comparator 44 about each hop. When it is considered that the hop with the maximum receiving intensity has received interference, and the level difference about each hop from the 2nd comparator 44 is smaller than the threshold of the 2nd threshold setting section 43, or it considers that the hop has received interference and lessens the weighting factor to this hop to the weight operation part 45, it orders to make it zero. In addition, you may make it change dynamically the set point of the threshold of the 2nd threshold setting section 41 so that it can respond to change of the receiving environment by the external factor.

[0048] According to the gestalt of this operation, as mentioned above the weight control section 12 The maximum receiving on-the-strength detecting element 23 which detects the maximum receiving intensity out of the receiving intensity of each hop, The average receiving on-the-strength detecting element 24 which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, The 1st comparator [search for the level difference of the maximum receiving intensity and average receiving intensity, and / difference / level / the 1st threshold] 42, The 2nd comparator [search for each level difference of the maximum receiving intensity and the receiving intensity of each hop, and / difference / level / each / the 2nd threshold] 44, When there is hop with few the maximum receiving intensity and level differences by having formed the weight operation part 45 which determines weight based on the 1st and the comparison result of the 2nd comparator 42 and 44 Since it can be made zero or it considers that the hop has received interference and lessens weight with the maximum receiving on-the-strength reception hop, influence of interference can be lessened further.

[0049] (Gestalt 5 of operation) Drawing 5 is the block diagram showing the weight control section of the receiving set for spectrum diffusion communication of the high-speed FH method by the gestalt 5 of operation of this invention. The composition of the receiving set for spectrum diffusion communication is the composition of drawing 1 like the gestalt 1 of operation, and the weight control section of drawing 5 newly adds a comparator and the threshold setting section in the gestalt 3 of operation.

[0050] In drawing 5 , since the receiving on-the-strength memory 21, the hop timing-control section 22, the maximum receiving on-the-strength detecting element 23, and the minimum receiving on-the-strength detecting element 31 are the same as that of drawing 3 , the same sign is attached and explanation is omitted. It is the 1st comparator to which 51 outputs the 1st threshold setting section, and 52 outputs the comparison result of the level difference of the output of the maximum receiving on-the-strength detecting element 23, and the output of the minimum receiving on-the-strength detecting element 31, and the threshold of the 1st threshold setting section 51. The 1st threshold setting section 51 and the 1st comparator 52 are the same as the threshold setting section 25 in the gestalt 2 of operation, and a comparator 26 respectively. It is the 2nd comparator to which 53 outputs the 2nd threshold setting section, and 54 outputs the comparison result of the level difference of each hop receiving on-the-strength output of the receiving on-the-strength memory 21, and the output of the maximum receiving on-the-strength detecting element 23, and the threshold of the 2nd threshold setting section 53.

[0051] The operation is explained about the weight control section constituted as mentioned above.

[0052] The receiving intensity in each hop is written in the receiving on-the-strength memory 21 by the timing according to the hopping timing which the hop timing-control section 22 outputs. In all hop per bit, the maximum receiving on-the-strength detecting element 23 detects the level of a hop number with the largest receiving intensity, and receiving intensity by the output from the receiving on-the-strength memory 21. Moreover, in all hop per bit, the minimum receiving on-the-strength detecting element 31 detects the level of a hop number with the smallest receiving intensity, and receiving intensity, and the level difference of the maximum receiving intensity from the maximum receiving on-the-strength detecting element 23 and the minimum receiving intensity from the minimum receiving on-the-strength detecting element 31 is calculated by the 1st comparison 52. Furthermore, when the value calculated by the 1st comparator 52 is over the threshold of the 1st threshold setting section 51, it considers that the hop with the maximum receiving intensity has received interference, and or it lessens the weighting factor to the hop with the maximum receiving intensity to the weight operation part 55, it orders to make it zero. In this case, to hop other than the hop with the maximum receiving intensity, the weight operation part 55 computes a weighting factor like the gestalt 1 of operation according to the level of the receiving intensity of hop. In addition, you may make it change dynamically the set point of the threshold of the 1st threshold setting section 51 so that it can respond to change of the receiving environment by the external factor. It is the operation same so far as the gestalt 3 of operation.

[0053] With the gestalt of this operation, the level difference of the value of the receiving on-the-strength memory 21 and the maximum receiving on-the-strength detecting element 23 which store the receiving intensity of each hop is further calculated by the 2nd comparator 54 about each hop. When it is considered that the hop with the maximum receiving intensity has received interference, and the level difference about each hop from the 2nd comparator 54 is smaller than the threshold of the 2nd threshold setting section 53, or it considers that the hop has received interference and lessens the weighting factor to this hop to the weight operation part 55, it orders to make it zero. In addition, you may make it change dynamically the set point of the threshold of the 2nd threshold setting section 53 so that it can respond to change of the receiving environment by the external factor.

[0054] According to the gestalt of this operation, as mentioned above the weight control section 12 The maximum receiving on-the-strength detecting element 23 which detects the maximum receiving intensity out of the receiving intensity of each hop, The minimum receiving on-the-strength detecting element 31 which detects the minimum receiving intensity out of the receiving intensity of each hop, The 1st comparator [search for the level difference of the maximum receiving intensity and the minimum receiving intensity and / difference / level / the 1st threshold] 52, The 2nd comparator [search for each level difference of the maximum receiving intensity and the receiving intensity of each hop, and / difference / level / the 2nd threshold] 54, When there is hop with few the maximum receiving intensity and level differences by having formed the weight operation part 55 which determines weight based on the 1st and the comparison result of the 2nd comparator 52 and 54 Since it can be made zero or it considers that the hop has received interference and lessens weight with the maximum receiving on-the-strength reception hop, influence of interference can be lessened further.

[0055] (Gestalt 6 of operation) Drawing 6 is the block diagram showing the receiving set for spread-spectrum communication of the high-speed FH method by the gestalt 6 of operation of this invention. If it is a mark (data "1") and is a space (data "0") about the sine wave of the frequency of fc+delta f as an information modulation technique like the gestalt 1 of operation, BFSK which outputs the sine wave of the frequency of fc-delta f is assumed. fc is the carrier frequency by which hopping patternizing was carried out.

[0056] In drawing 6 , since an antenna 1, BPF2, a frequency synthesizer 3, a frequency converter 4, BPF 5 and 6, the detection sections 7 and 8, and the hop data judging section 9 are the same as that of drawing 1 , the same sign is attached and explanation is omitted. The hop data error judging section which performs comparison with the 1-bit judging data of synthetic judgment section 64 output of the after-mentioned [61], and the judgment result in the hop data judging section 9, The error memory which memorizes the history of the error 62 was judged in the hop data error judging section 61 to be, The weight control section as which 63 determines a weighting factor by the error situation of the error memory 62, and 64 are the synthetic judgment sections which perform a weighting operation to each hop judging data from the hop data judging section 9 according to the weighting factor computed by the weight control section 63, and perform a synthetic judgment.

[0057] The operation is explained about the receiving set for spread-spectrum communication constituted as mentioned above.

[0058] The signal received by the antenna 1 passes only a diffusion frequency band signal by BPF2. If it is a mark and is fIF+deltaf and a space when the hopping synchronization can be taken and this band-limited signal and the sinusoidal signal which is the frequency of fc+fIF of frequency synthesizer 3 output are multiplied by the frequency converter 4, the frequency component of fIF-delta f is outputted. BPF6 cannot be passed although the output from a frequency converter 4 can pass BPF5 in a mark. BPF5 cannot be passed, although it is the reverse in the case of a space and the output from a frequency converter 4 can pass BPF6. The detection sections 7, such as an envelope detection, and the detection section 8 perform level detection to the output of BPF5 and BPF6, respectively. The hop data judging section 9 judges hop data by comparing the output level of the detection section 7 and the detection section 8 for every hop. If the data (each hop judging data) in each hop judged by the hop data judging section 9 are compared with the data result (judgment data) judged by the synthetic judgment section 64 and these two judgment data are in agreement It considers that the error has not generated the hop data, and if not in agreement, by considering that the error has generated the hop data, the error of the frequency corresponding to each hop will be detected, and the error generating history will be memorized by the error memory 62. By referring to the error generating history about each hop memorized by the error memory 62, the weight control section 63 calculates the frequency of error generating, considers that interference is received to the frequency in which error generating is occurring frequently, and or it lessens the weighting factor to this frequency, it is made into zero. The synthetic judgment section 13 performs weighting composition using the weighting factor computed by the weight control section 63 to the hop judging data from the hop data judging section 9, and 1-bit data are judged.

[0059] The hop data judging section 9 which carries out a data judging about each hop and which is outputted as hop judging data according to the gestalt of this operation as mentioned above, The synthetic judgment section 64 which

compounds each hop judging data from the hop data judging section 9, and performs a data judging, The hop data error judging section 61 which performs comparison with the judgment data outputted from the synthetic judgment section 64, and each hop judging data outputted from the hop data judging section 9, and judges whether it is an error, The error memory 62 which memorizes the error judging result outputted from the hop data error judging section 61, It has the weight control section 63 which determines weight based on the error judging result stored in the error memory 62. the synthetic judgment section 64 By having been made to compound each hop judging data based on the weight from the weight control section 63 The error generating situation for every hop is memorized by comparing each hop judging data with the judgment data after composition. Since it can be made zero or it considers that interference has occurred in the frequency corresponding to the hop which the error generated and lessens weight to the hop corresponding to the frequency, influence of interference can be lessened further.

[0060]

[Effect of the Invention] As explained above, according to the receiving set for spectrum diffusion communication of this invention according to claim 1 The hop data judging section which is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data, and carries out a data judging about each hop, The receiving on-the-strength detecting element which detects the receiving intensity of each hop, and the weight control section which performs a weight operation with the receiving intensity of each hop detected by the receiving on-the-strength detecting element, By having the synthetic judgment section which compounds each hop data judged in the hop data judging section with the weight called for in the weight control section, and performs a data judging Since weighting to the judgment result of each hop with the value by which the weight operation was carried out according to receiving intensity is performed While being able to earn synthetic gain as compared with the majority judging which is an exclusive operation and being able to secure good opposite noise figure Since the hard limiter composite system of using the hop judging data made binary in the synthetic judgment section is used, the advantageous effect that the good property under interference environment is maintainable is acquired.

[0061] According to the receiving set for spectrum diffusion communication according to claim 2, it sets to the receiving set for spectrum diffusion communication according to claim 1. a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, By searching for the level difference of the maximum receiving intensity and average receiving intensity, and having a comparator [difference / level / threshold] and the weight operation part which determines weight based on the comparison result of a comparator As for the receiving intensity of the hop which has received interference, a level difference with average receiving intensity becomes large. Since it can be made zero or it lessens weight of hop of the maximum receiving intensity, when it considers that the level difference exceeds a threshold and a threshold is exceeded, the advantageous effect that influence of interference can be lessened further is acquired.

[0062] According to the receiving set for spectrum diffusion communication according to claim 3, it sets to the receiving set for spectrum diffusion communication according to claim 1. a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop, By searching for the level difference of the maximum receiving intensity and the minimum receiving intensity, and having a comparator [difference / level / threshold] and the weight operation part which determines weight based on the comparison result of a comparator As for the receiving intensity of the hop which has received interference, a level difference with the minimum receiving intensity becomes large. Since it can be made zero or it lessens weight of the maximum on-the-strength reception hop, when it considers that the level difference exceeds a threshold and a threshold is exceeded, the advantageous effect that influence of interference can be lessened further is acquired.

[0063] According to the receiving set for spectrum diffusion communication according to claim 4, it sets to the receiving set for spectrum diffusion communication according to claim 1. a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The average receiving on-the-strength detecting element which asks for the average receiving intensity of other hop of those other than the maximum receiving intensity, The 1st comparator [search for the level difference of the maximum receiving intensity and average receiving intensity, and / difference / level / the 1st threshold], By searching for each level difference of the maximum receiving intensity and the receiving intensity of each hop, and having the 2nd comparator [difference / level / each / the 2nd threshold] and the weight operation part which determines weight based on the 1st and the comparison result of the 2nd comparator Since it can be made zero

or it considers that the hop has received interference and lessens weight with the maximum receiving on-the-strength reception hop, when there is hop with few the maximum receiving intensity and level differences, the advantageous effect that influence of interference can be lessened further is acquired.

[0064] According to the receiving set for spectrum diffusion communication according to claim 5, it sets to the receiving set for spectrum diffusion communication according to claim 1. a weight control section The maximum receiving on-the-strength detecting element which detects the maximum receiving intensity out of the receiving intensity of each hop, The minimum receiving on-the-strength detecting element which detects the minimum receiving intensity out of the receiving intensity of each hop, The 1st comparator [search for the level difference of the maximum receiving intensity and the minimum receiving intensity, and / difference / level / the 1st threshold], By searching for each level difference of the maximum receiving intensity and the receiving intensity of each hop, and having the 2nd comparator [difference / level / the 2nd threshold] and the weight operation part which determines weight based on the 1st and the comparison result of the 2nd comparator Since it can be made zero or it considers that the hop has received interference and lessens weight with the maximum receiving on-the-strength reception hop, when there is hop with few the maximum receiving intensity and level differences, the advantageous effect that influence of interference can be lessened further is acquired.

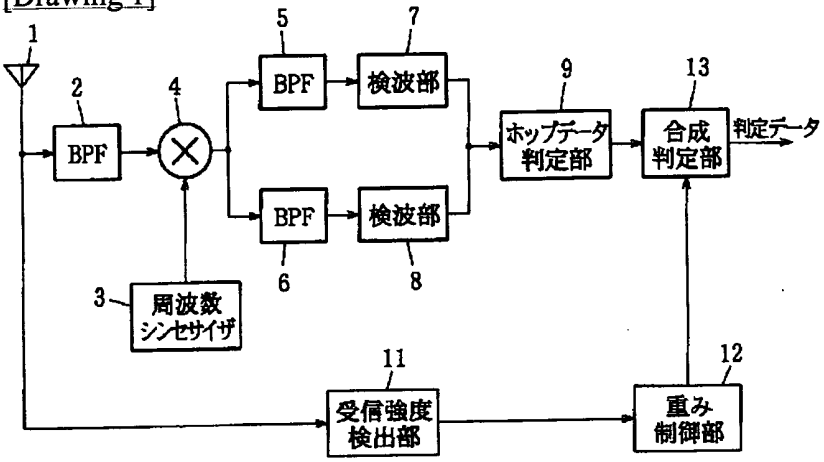
[0065] According to the receiving set for spectrum diffusion communication according to claim 6, it is a receiving set for spectrum diffusion communication using the high-speed frequency-hopping method which carries out multiple-times hop per 1 bit of data. The hop data judging section which carries out a data judging about each hop and which is outputted as hop judging data, The synthetic judgment section which compounds each hop judging data from the hop data judging section, and performs a data judging, The hop data error judging section which performs comparison with the judgment data outputted from the synthetic judgment section, and each hop judging data outputted from the hop data judging section, and judges whether it is an error, The error memory which memorizes the error judging result outputted from the hop data error judging section, It has the weight control section which determines weight based on the error judging result stored in error memory. the synthetic judgment section By compounding each hop judging data based on the weight from a weight control section The error generating situation for every hop is memorized by comparing each hop judging data with the judgment data after composition. Since it can be made zero or it considers that interference has occurred in the frequency corresponding to the hop which the error generated and lessens weight to the hop corresponding to the frequency, the advantageous effect that influence of interference can be lessened further is acquired.

[Translation done.]

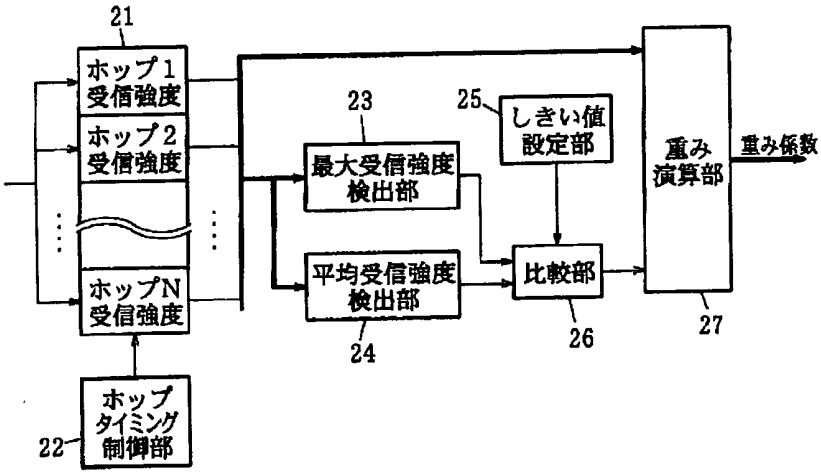
* NOTICES *

DRAWINGS

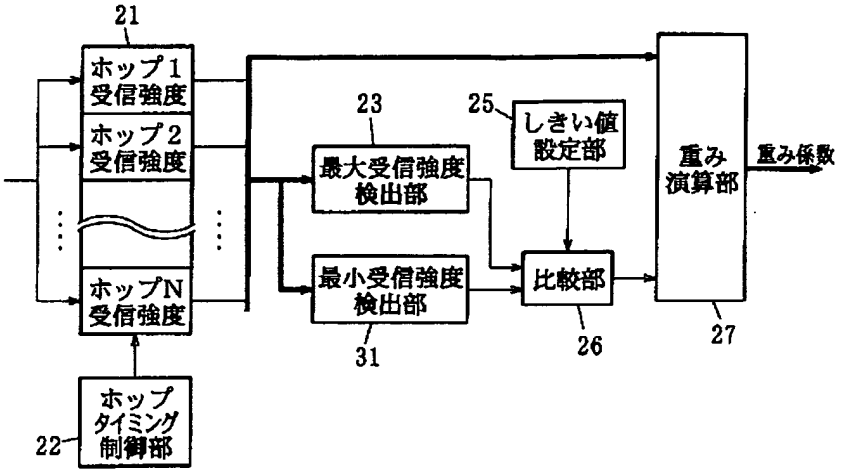
[Drawing 1]



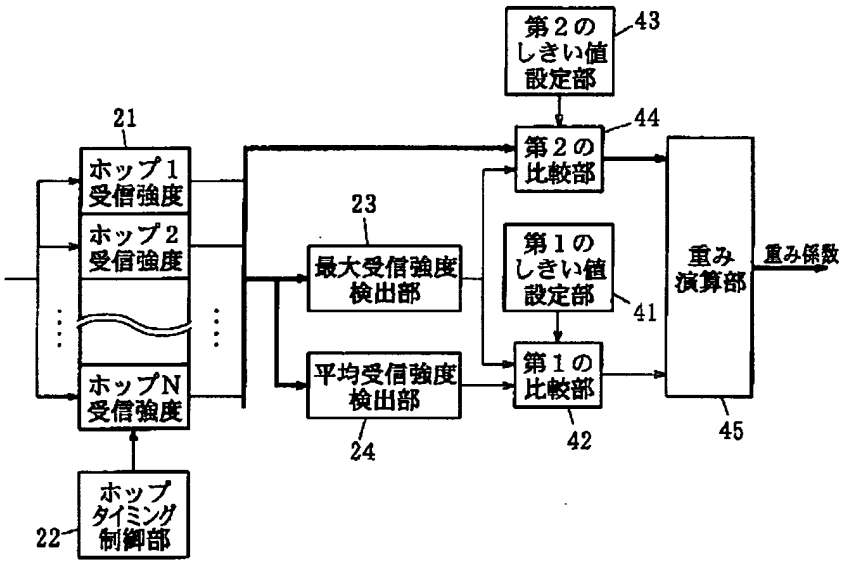
[Drawing 2]



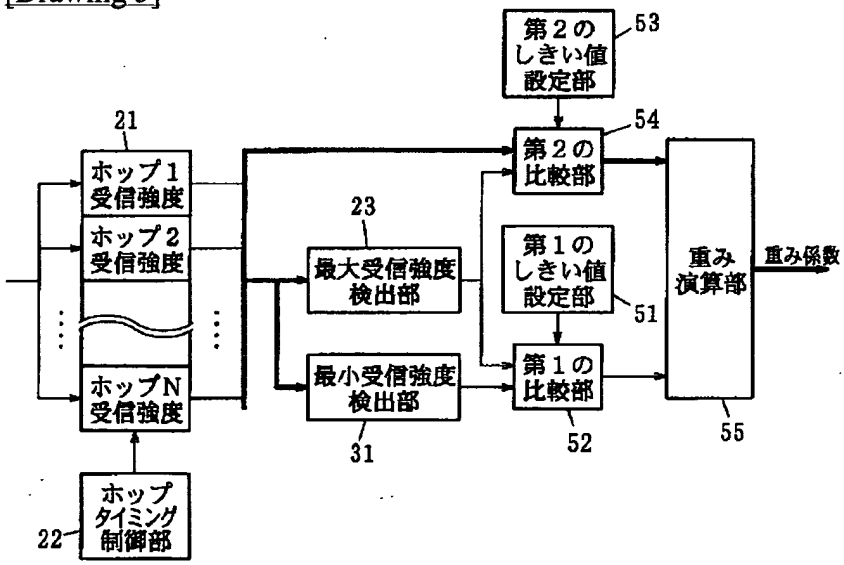
[Drawing 3]



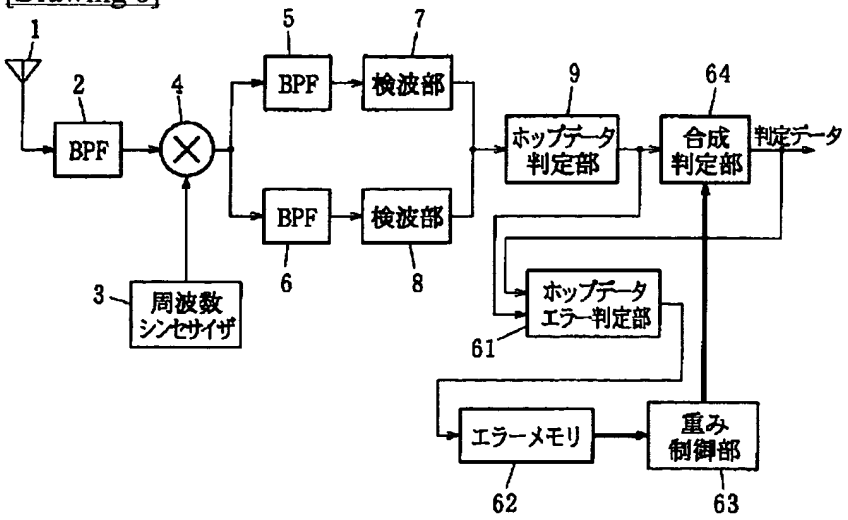
[Drawing 4]



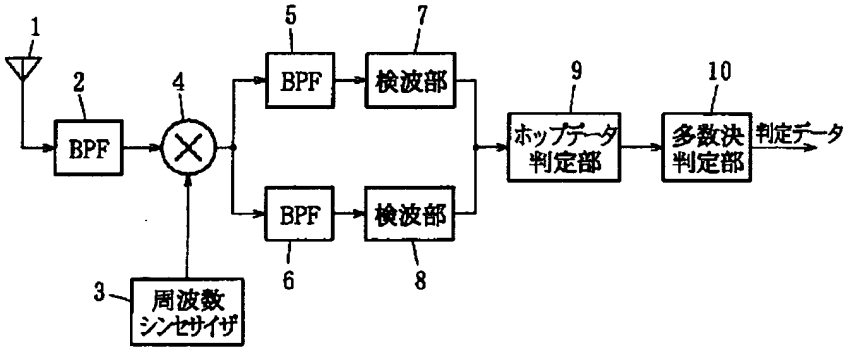
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]